X-ray Fluorescence Microprobe Delineates the Sequestration of Zn in the Brains of Rats with Adversely Affected Spatial Learning Resulting from Elevated Levels of Zn in Drinking Water

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Introduction: Zinc (Zn) is an essential nutrient and the adverse biological effects of Zn deprivation have been extensively studied. However, the problem of abnormally high Zn has received less attention. Rats raised on normal lab water enhanced with 10 ppm $ZnCO_3$ were assessed behaviorally for spatial learning deficits. The results suggest that long-term exposure to Zn at concentrations similar to those known to occur in the environment can have adverse affects on memory.

Methods and Materials: Quantitative micro-XRF imaging of 10-μm thick brain sections from treated and controlled rats were conducted at X-26A.

Results: Treated individuals exhibited spatially increased Zn in regions of the cortex and hippocampus, which are areas specific to memory and learning. Micro-XANES conducted with a 10 μm beam at Zn-enriched regions in thin sections taken from the treated specimen indicated that the Zn was primarily ligated to sulfur rather than oxygen. These findings suggest that this increased pool of Zn is not necessarily free but rather bound to sulfur-containing amino acids.

Conclusions: These results raise important questions about the effect of normal environmental Zn levels in learning and memory.

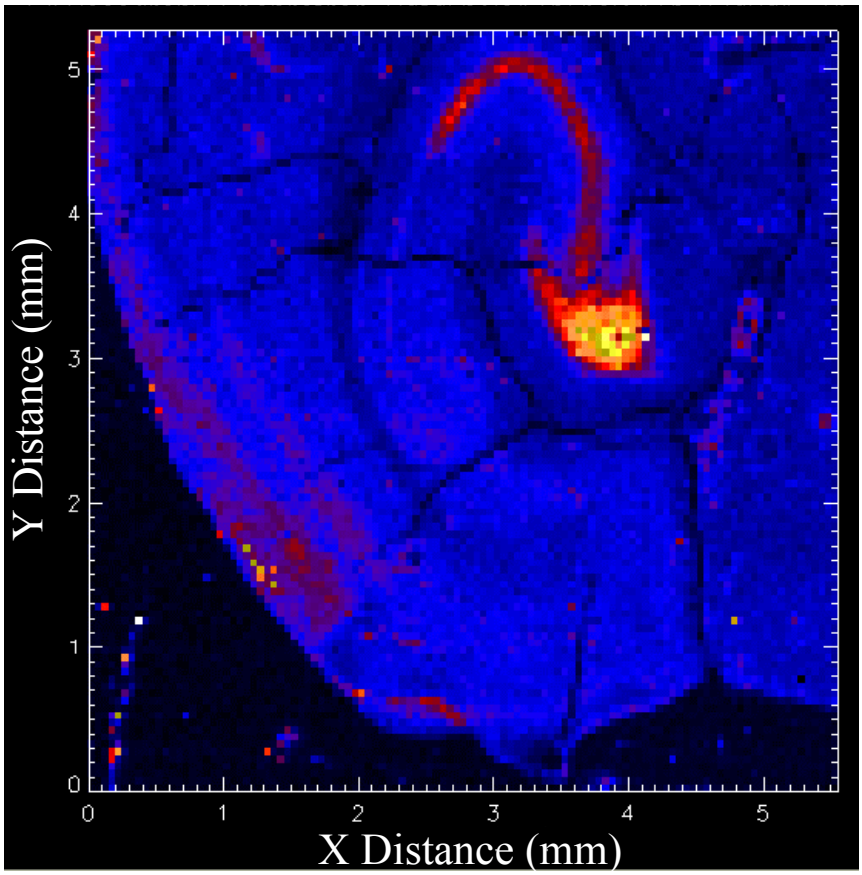

Figure 1. XRF map of Zinc distribution in the hippocampus and cortex region of a 9 month old Sprague-Dawley rat .